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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/057,674	01/24/2002	Jeng H. Hwang	AM-2602.C1	1101

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APPLIED MATERIALS, INC.  
2881 SCOTT BLVD. M/S 2061  
SANTA CLARA, CA 95050

EXAMINER

BARRECA, NICOLE M

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 03/14/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/057,674

Applicant(s)

HWANG ET AL.

Examiner

Nicole M. Barreca

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 24 January 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-28 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

### **DETAILED ACTION**

1. Claims 1-28 are pending in this application.

#### ***Specification***

2. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.
3. The use of the trademark SILK has been noted in this application. See p.35, l. 22, 28 and p.82, l.28. It should be capitalized wherever it appears and be accompanied by the generic terminology.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

#### ***Claim Objections***

4. Applicant is advised that should claim 9 be found allowable, claim 18 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k). It appears that claim 18 may have been meant to depend on claim 14, instead of claim 1.

5. Claim 19 recites that the etchant gas consists essentially of a halogen containing gas, a noble gas and an additive selected from HBr, BCl<sub>3</sub> and mixtures thereof. The claim has been interpreted by the examiner, based on the teachings of specification, as requiring a halogen containing gas other than the halogen containing additive gases of HCl or BCl<sub>3</sub>.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 10, 11, 13-16, 22, 23, 26, 27 are rejected under 35 U.S.C. 102(e) as being anticipated by Ye (US Patent 6,143,476).

8. Ye discloses a method for high temperature etching of materials such as copper, platinum, iridium, ruthenium and tungsten. Substrate 212 is a 1000 angstrom dielectric layer of silicon dioxide overlying a silicon wafer (not shown). A barrier layer 214 of tantalum nitride of approximately 500 angstroms thickness formed over the substrate 212. A conductive layer 216 (corresponding to the applicant's noble metal layer) of approximately 8000 angstroms is formed over the barrier layer 214, followed by a 500 angstrom layer 218 of tantalum nitride (corresponding to the applicant's inorganic

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protective layer in cl.1, 14 and inorganic first mask layer in cl.22). Ye teaches that conductive materials such as platinum, iridium and ruthenium may be used instead of copper (col. 6, 30-35, col. 10, 54-56). Organic masking layer 220 and silicon dioxide layer 222 (corresponding to the applicant's inorganic mask layer in cl.1, 13, 14, 19 and inorganic second mask layer in cl.22) is then deposited to a thickness of about 1000 angstroms, followed by patterned photoresist layer 224 (col. 8, 23-46). The pattern in the photoresist is transferred through layer 222 and layer 220 (applicant's step b). The photoresist layer 224 is then removed (step c). Optionally layer 222 may be removed also (step g). However if the thickness of the silicon dioxide layer is properly designed, this layer will be automatically removed during the patterning of feature layer 216. Barrier layer 218 and conductive layer 216 are then etched (steps d, e, f and h) using a feed gas of HCl, N<sub>2</sub> and BCl<sub>3</sub> at a temperature of about 250 °C. Layer 220 is then removed (step g). Other materials which may be used for the antireflective/barrier layers 214 and 218 include silicon oxynitride, tantalum, titanium nitride, tungsten titanate and tungsten nitride. See column 8, line 23 through column 10, line 56.

### ***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 12 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye.

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11. Ye does not disclose that the (second) mask layer has a thickness of about 6000-9000 angstroms. Ye however does teach that the thickness of the silicon dioxide layer should be chosen so that it will be automatically removed during the patterning of metal feature layer 216 (i.e. result-effective variable). It would be within the ordinary skill of one in the art to determine the optimal thickness for the (second) mask layer in the method of Ye by routine experimentation and to have the thickness be about 6000-9000 angstroms, if required, because Ye teaches that when the thickness of the silicon dioxide mask layer is properly designed it will be automatically removed during the metal etch and the discovery of an optimum value of a result effective variable is ordinary within the skill of the art (*In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

12. Claims 2-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye as applied to claim 1 above, and further in view of Hong (US Patent 6,046,113).

13. Ye is silent on if there is residual noble metal or residual protective material and does not disclose that this residual material is removed prior to etching the barrier layer. Hong teaches that residual layers remaining on the surface would interfere with later semiconductor processing (col.2, 26-29). It would have been obvious to one of ordinary skill in the art to remove the residual noble metal and residual protective layer in the method of Ye because Hong teaches that residual layers will interfere with later semiconductor processing.

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14. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye in view of Anderson (US 4,456,675) and Kornblit (US 5,948,570).

15. The teachings of Ye have been discussed above. Ye does not disclose that the silicon dioxide layer overlying the silicon wafer is an etch stop layer. Anderson teaches that silicon dioxide is a conventional etch stop material (col.9, 4-6). It would have been obvious to one of ordinary skill in the art that the silicon dioxide layer overlying the silicon wafer in the method of Ye was an etch stop layer because Anderson teaches that silicon dioxide is a conventional material used for etch stop layers.

Ye etches the noble metal layer using a halogen containing gas (HCl) and an additive of BCl<sub>3</sub>, but does not disclose the etchant gas to also include a noble gas. Kornblit teaches that noble gas may be added to etchant gas mixtures in order to increase ion flux, stabilize the plasma or both (col.4, 33-41). It would have been obvious to one of ordinary skill in the art to add a noble gas to the etchant mixture of Ye because Kornblit teaches that that noble gas may be added to etchant gas mixtures in order to increase ion flux, stabilize the plasma or both.

16. Claims 6, 9, 18, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye as applied to claims 1 or 22 above, and further in view of Kim (US 5,591,671).

17. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye in view of Hong as applied to claims 2 or 4 above, and further in view of Kim.

18. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye in view of Anderson and Kornblit as applied to claim 19 above, and further in view of Kim.

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19. Ye is silent on the deposition method used to form the silicon dioxide (second) mask layer and does not disclose that the mask layer is chemical vapor deposited (CVD) silicon dioxide. Kim teaches that CVD is a conventional method for depositing silicon dioxide (col.4, 29-30). It would have been obvious to one of ordinary skill in the art in the method of Ye, Ye in view of Hong or Ye in view of Anderson and Kornblit to deposit the (second) mask layer of silicon dioxide using CVD because Kim teaches that this is a conventional deposition method for this material.

20. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye in view of Anderson and Kornblit as applied to claim 19 above, and further in view of Kurino (US 5,613,296).

21. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye as applied to claim 22 above, and further in view of Kurino.

22. Ye discloses that the substrate includes a silicon dioxide layer (etch-stop) overlying the silicon wafer but does not disclose etching the etch stop layer (cl.20) or that the substrate is etched during etching of the barrier layer (cl.28). Kurino teaches that forming conductive paths through two consecutive insulating layers at the same time permits the reduction in the number of patterning and etching steps (col.4, 57-61). It would have been obvious to one of ordinary skill in the art to etch the substrate, in the method of Ye in view of Anderson and Kornblit (including the silicon dioxide etch stop layer overlying the silicon wafer) or in the method of Ye, at the same time as etching the



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barrier layer because Kurino teaches that this will reduce the number of patterning and etching steps.

23. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye as applied to claim 22 above, and further in view of Kobayashi (US 4,544,602).

24. Ye uses TaN as the first mask layer and does not disclose that the first mask layer is Si<sub>3</sub>N<sub>4</sub>, BSG, PSG, or BPSG. Kobayashi teaches that Si<sub>3</sub>N<sub>4</sub> and TaN may both be used as the material for the protective layer overlying a metal layer (col.3, 15-22). It would have been obvious to one of ordinary skill in the art to use Si<sub>3</sub>N<sub>4</sub> instead of TaN for the first mask layer overlying the metal in the method of Ye because Kobayashi teaches that either may be used as a suitable material for a protective layer overlying a metal layer.

### ***Conclusion***

25. The references cited in the specification are considered pertinent to the applicant's disclosure but not applicable.

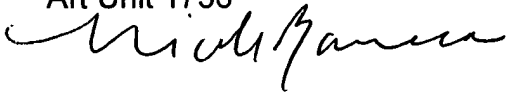
26. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 703-308-7968. The examiner can normally be reached on Monday-Thursday (8:00 am-6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Nicole Barreca  
Patent Examiner  
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A handwritten signature in cursive script, appearing to read "Nicole Barreca", written in black ink.

March 6, 2003